cultural students will remember with pride his high opinion of the work of the Rothamsted Experimental Station, with which he was unusually well acquainted. The Rothamsted data were constantly used by him in lectures and writings, and he maintained his personal interest in the work right up to the time of starting for Greece.

Two of Dr. Hopkins's books are well known in this country. One—"The Story of the Soil"—was written in the main during his long railway journeys in the States; it is an attempt to introduce scientific facts about the soil into the dialogue of a novel. It is not less attractive than other novels written with a purpose, and it is light reading. His more serious book is entitled "Soil Fertility and Permanent Agriculture"; it contains valuable summaries of the results of the more important field experiments, and an interesting and illuminating discussion. His own view was narrower than would be usually accepted by the younger generation of workers in America or in this country; he considered soil fertility to be essentially a matter of nitrogen, phosphate, and potash, and to be expressible in the terms of the actual weights of these substances in the soil. There are cases where this view would suffice, and many appear to have come within Dr. Hopkins's experience. These, however, would now be regarded as limiting rather than as normal cases, and more generally fertility would be considered to be the outcome of many factors, some chemical, some physical, others, again, biological. But Dr. Hopkins did much good work, training a splendid body of students, and developing a department which has added lustre to the great University of Illinois.

E. J. RUSSELL.

NOTES.

WE announce with deepest regret the death on Monday, December 29, at seventy years of age, of Sir William Osler, Bart., F.R.S., Regius professor of medicine in the University of Oxford.

MR. R. NATHAN, late Indian Civil Service and author of works on the history of plague in India and the progress of education in India, has been promoted by the King to the rank of K.C.S.I.; and Mr. G. S. Sankey, Inspector-General of Forests to the Government of India, has been given the honour of K.B.E.

DR. F. BROILI has been appointed professor of geology and palæontology in the University of Munich in succession to the late Prof. A. Rothpletz. Dr. Broili was a pupil of the late Prof. K. A. von Zittel, and is well known for his numerous contributions to vertebrate palæontology.

WE learn from Dr. Tolmatcheff, a Custos of the Russian Academy of Sciences, who is now in London, that when he left Petrograd early last summer the collections and libraries of the Academy, the School of Mines, and the Geological Survey were intact, and scientific men were being sympathetically treated by the Bolshevik Government. The most important specimens of the Permian reptiles collected by the late Prof. Amalitsky in northern Russia had been removed from Warsaw to the museum of the Academy of Sciences at Petrograd.

THE death is announced, in his sixtieth year, of Dr. Louis Valentine Pirsson, who had been professor of physical geology since 1897 at the Sheffield Scientific School at Yale, where for several years previously he had held various minor posts. Prof. Pirsson was a geologist on the staff of the U.S. Geological Survey and an associate editor of the *American Journal of Science.* He was the author of numerous scientific memoirs, text-books, and papers on geological and mineralogical subjects.

THE Photographic Arts and Crafts Exhibition, which was held annually until the war intervened, is to be resumed in the coming spring. It is renamed the Photographic Fair, and will be held at the Horticultural Hall, Westminster, on April 16 to 24. As usual, the Professional Photographers' Association will hold a congress at the same time in connection with the exhibition, while the Photographic Dealers' Association will, for the first time, organise a congress of photographic dealers. It is intended to afford dealers special facilities for examining the exhibits. The organising secretary of the fair is Mr. Arthur C. Brookes, Sicilian House, Southampton Row, W.C.1.

THE death of Mr. J. Hartley Wicksteed on December 16, at seventy-seven years of age, is announced. *Engineering* for December 19 gives some particulars of his career. Probably his inventions which have had most bearing on engineering progress are his vertical single-lever testing machine and his horizontal universal testing machine. Mr. Wicksteed was connected with the Institution of Mechanical Engineers for more than fifty years, and was president in 1903–4. He was one of the first members of council of the Yorkshire College, Leeds, afterwards becoming a life governor of the University; and through this and other local activities he exercised a wide influence. He became a member of the Institution of Civil Engineers in 1889.

BY the death of Dr. Harold Cecil Greenwood a few weeks ago, at thirty-two years of age, British engineering chemistry has lost one of its most promising younger members. Dr. Greenwood was always a careful and accurate worker, and applied that characteristic to even the smallest detail in every problem which he took up. As a result his work was exact; his data on the boiling points of metals, published in 1909, are generally accepted as the most accurate existing upon the subject. During the last three years of his life Dr. Greenwood was engaged on behalf of the Government on an extremely laborious undertaking: the construction of an experimental synthetic ammonia plant for the preparation of ammonia from its elements. In this work his training with Prof. Haber at Karlsruhe stood him in good stead, but it was no easy matter to translate laboratory experimental work to the semi-technical working-plant model producing 1 kg. per hour of ammonia, desired by the authorities. It was at this stage that his industrial experience with Messrs. Hutton at Sheffield aided him both in the choice of suitable materials and in the proper design of apparatus. No member of Dr. Greenwood's staff had had previous experience with the operation of gases under very high pressures or with the design of suitable plant, yet he not only brought his work to a successful issue, but he also effected the training of the staff in such a way that they could operate the extremely complicated plant unaided. This in itself is a tribute to his technical and executive abilities; and his work on "Industrial Gases," published since his death, is a worthy record of his knowledge of an important department of applied chemistry.

THE loss of that keen geologist, Prof. Joseph Barrell, of Yale, who died at the comparatively early age of fifty on May 4 of last year, will be felt far beyond those who met him and appreciated at first hand his mental energy and accuracy of perception. A sympathetic memorial of Prof. Barrell's work, with a portrait and bibliography, appears in the issue of the *American Journal of Science* for October last, and it is followed by two important papers by him on the theory of isostasy. An obituary notice of Barrell by Prof. Schuchert appears in *Science* (vol. xlix., p. 605, 1919). It is here pointed out that his reasoning powers were applied to the relations of climate to organic evolution, as well as to those problems of earth-structure that he made peculiarly his own.

THE Government of India has appointed a Committee, consisting of European and Indian experts, to inquire into the conditions and prospects of the sugar industry. At present most of the sugar produced is locally consumed in the crude form of "jaggery," but there seems little doubt that if capital and modern methods of manufacture could be introduced India might become one of the great sugar-producing areas in the world. The annual consumption of sugar in India, as elsewhere, has rapidly increased. India until recent years stood first of all the countries in the world in its area under sugar-cane and its estimated yield of cane-sugar, and even now ranks second only to Cuba. Yet it is notorious that the yield both of cane and raw sugar per acre and the available sugar extracted from the cane are undesirably low. In view of the conservative habits of the Indian peasant, the Government, in inducing him to adopt improved methods, has a difficult task to encounter.

AT a conversazione of the Eton College Scientific Society, held on December 15, a presentation from past and present members was made to the retiring president, Mr. W. D. Eggar, who, in returning thanks, referred to the losses which the society had suffered since the last conversazione in 1914, and in particular mentioned the names of W. S. Stewart, A. G. Parsons, and H. G. J. Moseley. Henry Moseley was "in college" with a brilliant band of classical scholars. He obtained his scholarship at Trinity, Oxford, in chemistry and physics, but the only paper which he contributed to the society was on deep-sea fishes. At the 1905 conversazione he demonstrated the simpler properties of those X-rays which afterwards he investigated to such purpose that his name, like that of Robert Boyle, links Eton with a law of Nature. After attending the British Association meeting in Australia, Moseley hurried back to join the Army, and fell in Gallipoli on August 10, 1915. Dr. Leonard Hill, who demonstrated in an amusing and instructive lecture the advantages of oxygen for athletes, deplored the loss to science in Moseley's death. Dr. R. Whytlaw Gray is the new president of the society.

THE council of the Scottish Meteorological Society proposes to hold a series of meetings, mainly in Edinburgh, at which lectures on popular lines will be given or discussions opened on questions of meteorological interest. The first of these lectures has, indeed, already been given in Glasgow by Capt. Franklin, who opened the winter session of the Royal Philosophical Society of Glasgow by an address on "The Study of Meteorology in Schools and Universities." The report of the council, adopted at the annual business meeting on December 19, refers to climatological stations maintained by voluntary observers, and says it has become evident that the country should no longer depend so largely on voluntary effort for a record of important economic factors. It is felt that those who may be in charge of any scheme of reconstruction should regard it as a vital matter that there should be a sufficient skeleton network of stations the permanence of which is guaranteed by some local authority or by some Government Department the interests of which are directly concerned. The president of the society for the ensuing year is Dr. C. G. Knott; vice-presidents, Prof. T. Hudson Beare and Mr. D. A. Stevenson; and hon. secretary, Dr. E. M. Wedderburn.

THE executive committee of the National Union of Scientific Workers has appointed Major A. Church to be whole-time secretary of the union, the appointment to date from January 1, 1920.

A NEW era of prosperity for the Zoological Society of London seems to have dawned. At the last monthly general meeting, held on December 17, it was announced that the number of visitors to the gardens from January 1 to November 30 showed an increase of 653,187 as compared with the previous year, while the money received for admission in the gardens during the same period showed an increase of 22,977*l*. as compared with the corresponding period in 1918.

WE are glad to note that vigorous measures are to be taken to suppress the practice of bird-liming in Lower Egypt. The Ministry of Public Works, Egypt, has just issued a report by Mr. J. Lewis Bonhote setting forth the hideousness of this traffic and the grave results to agriculture which must follow unless it is speedily stopped, for the victims are almost exclusively small, insectivorous birds. In an introduction to the report Major Stanley Flower, Director of the Zoological Service, remarks that in the past, in every normal year, practically the whole surface of the country was flooded, so that both the insect and rat population was swept away and drowned, with the exception of such comparatively small numbers as could survive by taking refuge in villages, in the tops of banks and trees, and on the desert fringes. The conditions within the last century have changed, and are becoming increasingly favourable for the spread of pests of agriculture. But there are serious difficulties to be overcome in certain districts in enforcing the law, as at Damietta, Fuwa, and Rosetta, owing to the "unpatriotic and uncivilised behaviour" of the local authorities.

Mr. T. Sheppard has reprinted from the Transactions of the East Riding Antiquarian Society (vol. xxii.) a paper on Danes' Dyke, the remarkable earthwork stretching across the triangular Flamborough headland from north to south. It is certainly much more ancient than the Danish period. Its shape and mode of construction demonstrate that it is not Roman. But in the same area, and associated with the earthwork, are numerous barrows, the implements, weapons, and ornaments found in them belonging to the Bronze age, though they also contain many fine stone implements, the use of which continued into the Bronze age. The results of some excavations made by Major-Gen. Pitt Rivers in October, 1879, are published in the Journal of the Anthropological Institute for 1880.

Sir W. Ridgeway describes in the November issue of *Man* a remarkable Irish decorated and socketed bronze axe, of which the provenance is doubtful, but it probably came from Co. Westmeath. The axe, 60 mm. (2⅖ in.) long, is remarkable because the maker made a careful scheme of ornamentation for the whole of its surface, dividing it into four compartments by means of four fine curved lines in relief, and adding the main feature, a band or frieze of chevrons, in refined and delicate relief running along the top of each side immediately under the delicate line running below the mouth of the socket. There is no similar specimen in the Irish National Museum or in the British Museum collections, now enriched by that of the late Canon Greenwell, nor does Sir John Evans describe any such in his "Bronze Implements." But Canon Greenwell possessed an Irish socketed axe with elaborate and refined decoration. This agrees fairly well with Sir W. Ridgeway's specimen, which is said to have come from Rathowen, Co. Westmeath, and there is at least some probability that the Ridgeway axe may have been made in that area.

The progress of boundary delimitation in Europe is the subject of a short article and a useful sketch-map by Mr. A. R. Hinks in the *Geographical Journal* for December (vol. liv., No. 6). The Treaty of Versailles delimited the boundaries of Germany, subject, of course, to the result of the plebiscites in Schleswig, East Prussia, Silesia, and, in fifteen years' time, in the Sarre basin. The Treaty of Saint-Germain-en-Laye delimited the boundaries of Austria subject to the result of the Klagenfurt plebiscite. The new frontier of Italy is not yet fixed in the north-east; the frontier of Hungary is fixed only in the west. Czecho-Slovakia's and Poland's frontiers are incompletely delimited. In Eastern Europe the frontiers are still vague. It is proposed to revise the sketch-map and reissue it from time to time in the *Geographical Journal.*

The Ordnance Survey decided in 1911 to undertake the levelling of an entirely new network in the British Isles to form the basis for a new series of bench marks and heights shown on the map. Experience has shown that many of the bench marks have altered their heights, either from subsidence or actual displacement; others have disappeared. The instruments and methods decided on for this work were described in a paper on "Precise Levelling" by Major E. O. Henrici read at the Institution of Civil Engineers on December 17. The new lines are laid out so that it is possible to erect special "fundamental" bench marks at intervals of about twenty-five miles. The marks of these will be fixed on solid rock or on concrete founded on rock. These marks have three reference points, one consisting of a metal bolt let into the top of a granite pillar, for general use, and two lower marks which are buried, and are for the use of the Survey only; they will serve in time to come to check the height of the upper mark. The probable error of the difference of height between any two consecutive "fundamental" marks may be about 0·01 ft. Intermediate bench marks take the form of gun-metal plates let into the surface of walls.

In his new pamphlet ("The Stanton Drew Stones," Bristol, 1*s*.) Mr. E. Sibree returns to the theme of his former publication ("Stanton Drew: A Calendar in Stone"), treating it in greater detail and with an abundant wealth of literary scholarship and interesting folk-lore. The circles of 30, 12, and 8 stones respectively are referred to the days of the month, the months of the year, and the years of the Venus cycle of intercalation. Eight years of 12 months, each of 30 days, contain 2880 days; if to these are added 12+30 days we get 2922 days, very nearly eight solar years. Mr. Sibree shows that the same number is obtained from the Carnac stone calendar in Brittany. He draws the conclusion that the Stanton Drew calendar was erected by Romans or by Romanised Britons in about the fifth century. Some confirmation is afforded by the fact that the diameters of the circles are 375, 150, and 100 Roman feet respectively, proportional to the numbers of stones in the circles, and by the presence of the Guild of Calendaries at Bristol in about A.D. 700. Much of the lore of Merlin and of the Welsh mythology is invoked to support this conclusion. It must be urged, however, that the lateness of the author's date is surprising. The geometrical interpretation of the construction of the circles is very artificial and too complicated to be accepted as the intention of the erectors; in any case, it is really irrelevant to the main theme of Mr. Sibree's pamphlet.

Mr. A. L. Sheather describes a malaria-like parasite found in the blood of an Indian buffalo. The animal suffered from irregular attacks of fever and anæmia, and eventually died. The parasites occurred in considerable numbers and in three forms– small, large, and dividing (Agricultural Research Institute, Pusa, Bulletin No. 90). Malaria-like parasites in the blood of ruminants seem to have been recorded only by Bruce, who found two antelopes infected in Nyasaland in 1913.

IN the recently issued fascicle iv. of "Contributions à la faune des Indes néerlandaises" (vol. i.), published by the Instituts scientifiques de Buitenzorg, Dr. Paul van Oye gives an account of the Chætognatha found in fifty-one samples of plankton taken off the north coast of Java. He describes five new species of Sagitta and one of Krohnitta, and founds a new genus Zahonya. Details are given of the horizontal distribution of the various species. Dr. A. L. J. Sunier has examined the collection of Stomatopoda in the fishery station and in the museum at Buitenzorg. The specimens prove to belong to known species of Squilla, Pseudosquilla, Odontodactylus, and Gonodactylus. Notes are given on seventeen species, the known geographical range of several of which is considerably extended.

IN the paragraph in these columns on September 25 (p. 78) referring to a paper by Mr. E. W. Vredenburg on "Observations on the Shells of the Family Doliidæ," the statement that "it appears that the genus Dolium is not known in formations older than the Oligocene" is in need of correction. Mr. E. A. Martin writes to point out that a Cretaceous Dolium is mentioned in Mantell's "Medals of Creation" and in the same author's "Geology of Sussex" (1822, p. 196). This was described and figured as *Dolium nodosum* by Sowerby in 1825 ("Mineral Conchology," vol. v., p. 34, pls. 426, 427). The figures represent casts of a large species of this genus. An analogous, if not identical, species of Dolium is recorded by W. C. Williamson from the Cretaceous formation of Mount Gebeel Suneen, part of the Lebanon range, immediately above Beyrout (Proc. Geol. Soc. Lond., iii., 1840, p. 291).

DR. NATHAN MUTCH describes in the Journal of the Royal Microscopical Society (pt. 3, September, 1919, p. 221) a comparatively simple procedure for the isolation of a single bacterial cell. It consists essentially in making a very dilute emulsion of the culture and transferring a minute drop of this to a sterile cover-glass, which is quickly mounted on a cell so as to form a hanging-drop preparation. A ring of filter-paper moistened with saline solution is placed on the bottom of the cell, and serves both to prevent evaporation from, and addition of moisture to, the hanging drop, which thus maintains a constant size. The preparation is then examined microscopically, and if a single cell only is found to be present, a drop of melted sterile agar is added to the drop on the cover-glass, the preparation remounted on the cell, incubated, and a growth is thus obtained.

WE learn, from *California Fish and Game*, vol. v., No. 4, that in 1919, for the first time in several years, squid were caught in abundance at Montery, California. Three Chinese firms have dried, in the past season, about 1,772,000 lb. of this mollusc. Three tons of wet furnish one ton of dried squid. Practically the whole of the harvest was sent to China. But, apparently by way of experiment, a small percentage of the catch was canned, while some was put upon the market in a fresh state, and is, it would seem, slowly winning favour as a table delicacy. Squid tentacles are said to rival the oyster in flavour. The kelp industry, which was started during the war to furnish potash, seems, from this number, to have come to an end. But it is hoped that the plant will be re-started on a paying basis by the sale of certain by-products which are obtainable during the process of extracting the potash. No hint, however, is given as to the nature of these promising substances.

THE *Journal of Agricultural Research* for October 15 contains two interesting contributions to the study of plant nutrition. By determining the composition of barley at successive stages of its growth in soil, Mr. J. S. Burd demonstrated considerable losses of potassium and nitrogen from the plant at the beginning of ear-formation, at which period the water-extract of the soil has a minimum concentration. The author considers that the most important condition of the soil solution for a high yield is an adequate supply of nutrient elements during the first half of the growth-period; subsequent high concentration is unnecessary, and may be undesirable. Similar results were obtained by Mr. D. R. Hoagland in carefully controlled sand and water cultures. Marked absorption of all nutritive elements occurred throughout growth if suitable concentrations of the medium were continuously maintained, but the absorption in the later stages of growth led to no important increase in yield. Attention is directed to the necessity of clearly distinguishing between the concentration and the total supply of essential elements in the nutrient solution, since rapid absorption by the plant may produce considerable alterations in the composition of the solutions.

A REPORT of the Meteorological Committee for the year ended March 31, 1919, has recently been issued. This is the first report since the Armistice, and much interesting information is given in it. Immense strides have been made in meteorology, and the Meteorological Office has expanded accordingly, dependent on the necessities of the war. Whereas the sum available, including many costs for the Services, in the year 1913–14 was 29,380*l*., in 1918–19 it was 66,371*l*. A much greater demand was made on the office for meteorological instruments, and for forecasts of all descriptions, including the upper air. The marine division, on the other hand, which is dependent for its information on the Royal Navy and mercantile marine, experienced a great falling off in the number of documents received from observers at sea, the documents numbering 2738 in the year 1913–14 and only 43 in 1918–19. Throughout the war there was great activity in the supply of data to the Army, Navy, and Air Service, and the work commonly undertaken in times of peace was greatly augmented, although most of the information was considered private and was withheld from the general public. The restrictions upon the circulation of meteorological information were removed after the signing of the Armistice.

Reports for the several branches of the office show the variety and extended work now undertaken. Any future report will presumably be made through the Air Ministry, to which the Meteorological Office is now responsible.

EXPERIMENTS have been carried out by Prof. Garelli, of Turin, on behalf of the Italian Government, with the view of extracting nitrate of ammonia from surplus stocks of explosives. According to *La Nature* of November 29 last, the explosive mixture is placed in special receptacles, a fixed quantity of water added, and the whole allowed to stand. A dense solution of nitrate of ammonia is then formed, which is separated by decantation. Powdered peat is then added to this solution, and after mixing and drying the product thus obtained it becomes a species of manure which is called "nitric peat." This material, which has the appearance of a blackish powder, has the following composition:—Water, 17·8 per cent.; ash, 18·8 per cent.; nitrate of ammonia, 42·8 per cent.; and organic matter, 20·6 per cent. Tests for ascertaining its value as a fertiliser have been carried out in the Alba district of Italy, and the results show that the action of this fertiliser is nearly equal to that of nitrate of soda.

DR. A. E. H. TUTTON has recently published in the Proceedings of the Royal Society (A, vol. xcvi., pp. 156–84) the results of an exhaustive study of the crystallographic properties of the monoclinic double selenates of the cobalt group, $R_2Co(SeO_4)_2,6H_2O$, where R stands for potassium, rubidium, cæsium, and ammonium successively. Only the potassium and ammonium salts of the group had previously been studied. The results fulfilled expectation, and fully accorded with those obtained for the zinc, magnesium, nickel, and iron groups, and for the eight known groups of the analogous double sulphates. The dominating facts brought out are, first, the progressive character of all the crystallographic and physical properties following the alkali metals concerned, potassium, rubidium, and cæsium; and, secondly, the almost perfect isostructure of the crystals of the ammonium and rubidium salts of the group.

THE Australian Institute of Science and Industry has published at Melbourne a pamphlet on "Engineering Standardisation," by Mr. Gerald Lightfoot. The objects of standardisation in cheapening manufacture and reducing maintenance charges and stocks, and in securing interchangeability of parts, are discussed. The British Standards Association is described, and under its influence other similar bodies are being formed in various countries. It is argued that if Australia neglects to take action, it will be impracticable to develop her engineering industries at the same level as in other countries. The institute desires to carry out research work on lines similar to those in the case of the U.S. Bureau of Standards and the National Physical Laboratory. The outline of a scheme for the formation of a Commonwealth Engineering Standards Association is given. It is mentioned that there is a multiplicity of voltages in electrical supply in Australia, and that merchants have to stock lamps for about twenty different voltages.

VOL. XIII. of the Transactions of the Rochdale Literary and Scientific Society contains the papers that have been read before the society during the years 1917–19. These papers, some fifteen in number, are entirely devoted to local subjects, and are mainly concerned with the history of the town and its institutions. There is a short article by Mr. E. L. Taylor on the Rochdale Grammar School (an old foundation dating back to 1564), two papers on the old Rochdale roads by Dr. Ashworth and Mr. A. P. Wadsworth, an annotated list of Querns found in the Rochdale district by Mr. J. L. Maxim, and a topical contribution by Mr. G. E. Leach on the connection of Rochdale with Peterloo in 1819. Of immediate interest to scientific readers we may note the interesting presidential address by Dr. Ashworth, in which he gives a brief but clear statement of the great and important part which Lancashire men and institutions have played in the striking advances which have taken place in electrical science during the last hundred years. The Rev. T. A. Jefferies contributes a short but suggestive paper on the natural transformations in the vegetation of Blackstone Edge, in which he traces the life-cycle of its plant associations. Dr. Ashworth's paper on atmospheric pollution in Rochdale provides the local authorities with a valuable mass of facts on which to base legislative action to mitigate the evils of smoke, unfortunately inevitable in large industrial areas. Altogether, the volume is an excellent example of the kind of research work, both historical and scientific, which it is the peculiar province of local societies to undertake.

A VOLUME devoted to the "Life and Letters of Silvanus Phillips Thompson" has been prepared by his wife and his daughter, Miss Helen G. Thompson, and will be published by Mr. T. Fisher Unwin in the spring. Many of the letters relate experiences on journeys abroad, some record adventures of the antiquarian in pursuit of early scientific literature, while others tell of battles for truth in some field or other. A few chapters deal solely with Thompson's scientific and public work, and contain appreciations of his books and original papers. Throughout the work there are many indirect testimonies to the warmth of personal regard which the frank geniality of his nature won for him and to the influences he exerted on the lives of those he met.

Messrs. George Bell and Sons, Ltd., will publish almost immediately "The Year-book of the Universities of the Empire" for 1920, edited by W. H. Dawson. The latest list of the *Cambridge University Press* includes:—The late Prof. J. H. Poynting's "Collected Scientific Papers," edited by Dr. G. A. Shakespear and G. Barlow, with biographical and critical notices by Sir Oliver Lodge, Sir Joseph Larmor, Sir J. J. Thomson, and Dr. G. A. Shakespear; "An Introduction to the Study of Cytology: An Outline of the Main Facts of Cytology for Advanced Students," Prof. L. Doncaster; "The Foundations of Einstein's Theory of Gravitation," E. Freundlich, translated by H. L. Brose; "A History of English Philosophy," Dr. W. R. Sorley; "Discovery in Greek Lands," F. H. Marshall; and "Life and Labour in the 19th Century," C. R. Fay. *Messrs. Constable and Co., Ltd.*, announce "Montessori Experiments," Miss Blackburn. Prof. Patrick Geddes has written a volume, which *Messrs. Longmans and Co.* will issue shortly, on the life and work of Sir Jagadis Chandra Bose, the founder of the Bose Research Institute in Calcutta.

OUR ASTRONOMICAL COLUMN.

FIREBALL ON DECEMBER 25.—A brilliant fireball was visible on Christmas night at 10h. 21m. at Bristol. It must have very much exceeded Venus in lustre, for it gave a flash which illumined the whole sky, and in that section of its flight where the greatest outburst occurred it left a streak about 3° long for 40 seconds. The apparent path was from $115^\circ+34^\circ$ to $105\frac{1}{2}^\circ+1^\circ$. The motion was rather swift, the course of about 35° being traversed in 2 seconds. The radiant point is doubtful; it may have been at $165^\circ+73^\circ$, $219^\circ+75^\circ$, $245^\circ+72^\circ$, or $261^\circ+62^\circ$. If the second is the correct position, the meteor may quite possibly be considered to have been a fragment of Mechain-Tuttle's comet, which has a period of about $13\frac{1}{3}$ years. Further observations of the object would be valuable, and should be sent to Mr. W. F. Denning, 44 Egerton Road, Bristol.

COMETS.—The following continuation of the ephemeris of Finlay's comet is for Greenwich midnight, from the elements in Lick Bull. 325:—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Jan. 2 ...	3 3 35	21 47	0·1703	9·8160
6 ...	3 12 57	22 24	0·1806	9·8510
10 ...	3 22 24	22 58	0·1911	9·8849
14 ...	3 31 21	23 27	0·2013	9·9173
18 ...	3 40 9	23 55	0·2114	9·9485

The comet will traverse the Pleiades on January 18.

It is calculated that Holmes's comet passed perihelion about November 30, and a search ephemeris was published. The comet is probably too faint to give much hope of its recovery. It has not been seen for two revolutions.

RADIATION PRESSURE.—The *Astrophysical Journal* for October last contains an article by Mr. Megh Nad Saha in which the opinion is expressed that the quantum theory of light will explain the repulsion of particles much more minute than those the dimensions of which are of the order of a wave-length. In the undulatory theory the repulsion is a maximum for particles of that order of magnitude, and becomes practically zero for those of the dimensions of molecules. Mr. Saha quotes the results of spectrum analysis of comets' tails, and some laboratory experiments by Lebedew (*Ann. der Physik*, 1910), for the fact that gaseous molecules actually do suffer repulsion by radiation pressure, which he considers an argument in favour of the quantum theory.

Assuming that a pulse of light gives all its momentum to a hydrogen atom, the velocity imparted to the latter by each "kick" would be 60 cm./sec. Some calculations are given, from which the author deduces that by repeated "kicks" the atom might acquire a velocity of 6×10^7 cm./sec., which has sometimes been observed in the solar prominences.

THE ORION NEBULA.—We lately noted Dr. Bergstrand's estimate of the parallax of this object, 0·0078″. Prof. W. H. Pickering (Pubns. Ast. Soc. Pac., April, 1919) contends for the value 0·0020″. This is deduced from assumptions of the absolute magnitudes of a number of faint stars which appear to be associated with the nebula. By comparing their photographic with their visual magnitudes, he concludes that their spectral type is A or B, whence their absolute magnitude is unlikely to be very low. But this involves the conclusion that the brighter stars in Orion are super-giants. Rigel in particular would have 87,000 times the luminosity of the sun. But perhaps it is nearly as easy to accept this as the value 5000 times the sun, which results from Dr. Bergstrand's parallax. Prof. Pickering estimates for the masses of the faint B7 stars in the nebula only four times that of Jupiter, using his parallax. With Kapteyn's parallax 0·0054″, the mass would be one-twentieth of this. Either value seems far too small for a body to attain the temperature necessary to shine as a B star.

SPHERICAL SHELL CRYSTALS IN ALLOYS.

AT the autumn meeting of the Institute of Metals recently held in Sheffield, Dr. J. E. Stead presented an account of his investigations on some ternary alloys of tin, antimony, and arsenic, one of which was noticed by him to crystallise in a most unusual and remarkable way.

Having found that the alloys of antimony and tin crystallise in what appear to be cubic crystals, and those of in and arsenic in rhombohedral flat plates, he made trials with the object of finding how the metals would arrange themselves when the three elements were fused together and the melt allowed to cool. The results obtained were astonishing, for the crystals found in the matrix had the form of incomplete spherical shells, the radii of which were small or great, according to the time allowed for development. With rapid freezing the radii were less than half a millimetre; when it was protracted for one hour they were 5 mm. or more. The most perfect structural arrangement of the crystals was obtained in an alloy containing from 70–85 per cent. of tin, 25–15 per cent. of antimony, and 4–5 per cent. of arsenic. Whether cooled slowly or quickly, the polished surface of the alloys, after dissolving away the matrix, is very suitable for printing blocks, since the hard crystals stand out in bold relief (see Fig. 1). The alloys are very brittle, and the fracture was found to travel midway along the shell walls. An alloy containing tin 70 per cent., antimony 25 per cent., and arsenic 5 per cent. gave the following arrests on cooling:—

(1) First separation of crystals ... 440° C.
(2) Retardation in cooling between 325° and 320° C.
(3) Solidification of the eutectic ... 244·9° C.

The last-named temperature agrees closely with that of the eutectic of the tin-antimony alloys. The conclusion is, therefore, warranted that the eutectic cannot contain more than a trace of arsenic, an inference confirmed by experiment. It was afterwards shown by analysis that the primary crystals contain a maximum amount of arsenic, and that, as crystallisation proceeds, the deposits contain less and less of this metal.

A large number of ternary alloys were prepared. It was found that, while it required 2·5 per cent. of arsenic in the presence of 25 per cent. of antimony to produce slightly curved crystals, 0·5 per cent. of arsenic in the presence of 3·75 per cent. of antimony yielded curved segments in the upper layers. In an alloy containing 1·65 per cent. of arsenic, 14·35 per cent. of antimony, and 85 per cent. of tin, spherical crystals were found in the top layers, below these smaller seg-